BOOSTING OUT OF THE BLINK: AN ATTEMPT TO MODULATE THE ATTENTIONAL BLINK EFFECT USING THE ATTENTIONAL BOOST EFFECT

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Abstract

Memory depends on attention. This principle is demonstrated in two different phenomena in attention and memory: the attentional blink effect and the attentional boost effect. The attentional blink effect is a memory deficit that occurs when targets are presented in rapid succession of each other. The attentional boost effect is a memory enhancement that occurs when participants respond to target stimuli while attending to a second set of stimuli. The current study examined whether an attentional boost effect manipulation could reduce the attentional blink deficit by having participants respond to auditory targets presented simultaneously with target words. A follow-up experiment attempted to replicate an earlier study that reduced the size of the attention blink deficit using sound alone, without the boost manipulation (Olivers and Van der Burg, 2008). Results showed no modulation of the attentional blink effect in the first experiment, but a modulation in the second experiment, wherein sound presented simultaneously with a target improved memory accuracy. Results suggested that the attentional boost effect may need to be applied through one modality in order for a modulation of the attentional blink effect to occur.
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Boosting out of the Blink: An Attempt to Modulate the Attentional Blink Effect Using the Attentional Boost Effect

Attention is an important aspect of everyday functioning. It acts as a filter that allows us to focus on some things, while ignoring others. Take the example of texting and driving—when attempting to do both tasks simultaneously our attention system becomes overwhelmed and performance is impaired in both tasks. On the other hand, focusing on just one task (e.g., driving) leads to improvement in that task. It is also well documented that memory depends on attention. When there is a deficit in attention or when the system is overwhelmed, there is a corresponding deficit in memory. When there is an enhancement in attention, there is often a corresponding enhancement in memory.

Extensive research has examined the importance of attention on memory. For example, Smith and Burrows (1974) found a link between attention and short-term memory, as memory performance suffered for unattended stimuli (i.e., when attention was divided) compared to attended stimuli (i.e., when attention was focused). Their research demonstrated both principles in the link between attention and memory. Dual-task conditions led to a deficit in attention, which in turn led to a deficit in memory. On the other hand, single task conditions led to an improvement in attention, which in turn led to an improvement in memory.

The strong link between attention and memory is further demonstrated by two independent effects in the psychological literature: the attentional blink effect and the attentional boost effect. The attentional blink effect is a robust phenomenon that was first reported by Broadbent and Broadbent (1987). Since that time, hundreds of empirical papers have been published investigating the nature of the effect. In the traditional methodology, participants are presented with a stream of words, containing a mix of
distractors and two targets, using a rapid serial visual presentation (RSVP) task. At the end of each trial, participants report the identity of the two targets. The first target (T1) is typically recalled correctly, but the second target (T2) is often missed, if T2 appears within 500 ms after T1. This finding has been taken as evidence that inadequate attention leads to poor short-term memory.

On the other hand, Swallow and Jiang (2010) demonstrated that engaging attention can lead to an enhancement of memory. Using a similar RSVP task, participants were asked to memorize a series of pictures, but to simultaneously monitor the pictures for an unrelated target square, embedded in some of the pictures, amongst a stream of distractor squares, embedded in the rest of the pictures. Memory performance was better on trials in which a target square was detected than on trials with distractor squares. Swallow and Jiang named this finding the attentional boost effect and took it as evidence that engaging attention can lead to enhancement in long-term memory. The attentional blink effect and the attentional boost effect demonstrate that memory performance depends on attentional engagement.

The purpose of the present study was to investigate whether combining an attentional blink procedure with an attention boost procedure would lead to a reduction in the typical T2 recollection deficit.

**The Attentional Blink Effect**

Shapiro, Arnell, and Raymond (1997) further developed the two-target RSVP procedure to measure the attentional blink effect. A white target letter (T1) was presented among a series of black distractors letters. On half the trials, a second target (T2) also appeared as a black letter “X”. At the end of each trial, participants were tasked with
recalling the identity of the T1 letter, as well as reporting whether the T2 “X” was present. Using this method, Shapiro et al. (1997) found an attentional blink effect. That is, participants had trouble reporting the presence of T2 if it appeared shortly after the presentation of T1. This group of researchers were the first to use the term *attentional blink* to describe this pattern of results because it was as if attention ‘blinked’, missing T2 in the stream of items (Raymond, Shapiro, & Arnell, 1992). Inherent in this RSVP procedure is the task of selectively attending to information in time; that is, selectively attending to two target items spaced in time amongst distractor items. Attending to T1 requires attentional resources, that are then not available when T2 appears after a short temporal window (< 500 ms, Shapiro et al., 1997).

Using a clever methodology, MacLellan, Shore, and Milliken (2015) added a spatial selective attention demand to the task, thus creating a procedure which manipulated selective attention in both time and space. In their procedure, participants are presented with two targets (i.e., T1 & T2), separated in time by a variable stimulus onset asynchrony (SOA). On half the trials, the T1 word is presented alone; on the other half of trials, the T1 word is presented interleaved with a distractor word. Thus, attention must be used to select information spatially in order to identify T1, but also temporally to identify T2. The presence of the distractor word interleaved with T1 is enough to engage attention sufficiently to disrupt the temporal selection of T2 (i.e., the attentional blink effect), especially when the SOA between targets is short.

**Theoretical Accounts of the Attentional Blink Effect**

**Interference Theory**

It has been argued that the attentional blink effect occurs due to interference in
processing between targets and the items that immediately follow them (Isaak, Shapiro, & Martin, 1999; Raymond, Shapiro, & Arnell, 1995; Shapiro, Raymond, & Arnell, 1994). According to this perspective, participants create perceptual representations of each item and these representations then compete for retrieval in the short-term memory storage buffer (Shapiro et al., 1994). Targets and the items that follow them are weighted in working memory. Items are weighted on their priority, giving targets more weight than other items. When T2 closely follows T1 in time, it is given less weight because there is not enough space for both T2 and T1 in working memory (Shapiro et al., 1994). A competition to retrieval between T1 and T2 ensues, with T1 usually winning because of its higher weighting.

A similar competition was proposed by Ward, Duncan, and Shapiro (1996) with their attentional dwell time hypothesis. These authors argue that T1 and T2 compete for visual processing resources, but that there are not enough resources to adequately process both targets. Whichever target wins the competition receives more processing, while the loser receives less processing. Because T1 occurs earlier in the RSVP stream, it is generally the winner. As such, T2 receives fewer processing resources and is more susceptible to interference from distractors (Ward et al., 1996).

The degree of interference from distractors also depends on how conceptually similar these items are to the targets. Isaak, Shapiro, and Martin (1999) adjusted the RSVP task so that the items following the letter targets were either pattern masks or letter distractors. The results indicated that the magnitude of the attentional blink effect increased when the number of categorically similar competitors increased. That is, when the distracting items are categorically similar to the targets, they produce more
interference, resulting in a larger attentional blink effect, than when the distracting items are categorically dissimilar. Thus, according to interference theory, the size of the attentional blink effect not only relies upon the number of competitors, but also on whether the competitors are conceptually similar.

Moreover, when T1 is followed by a blank interval, the attentional blink effect is significantly reduced (Raymond, Shapiro, & Arnell, 1992). In addition to identifying a white letter target amongst a stream of black letters, on half of the trials Raymond et al. presented participants with a black “X” target. Participants were required to identify the white letter and also determine whether the black “X” was present or absent. In one experiment, a blank interval of variable duration was presented between the presentation of T1 (i.e., the white letter) and the following distractor. In this case, the attentional blink effect was significantly reduced. In a follow-up experiment, the authors placed the variable blank interval between the first and second distractors that followed T1. In this case, Raymond et al. report a significantly larger attentional blink effect. These findings—that the closer in temporal proximity the distractor items follow the target, the greater the processing deficit—were taken as evidence that interference from post-target distractors causes the attentional blink effect.

The procedure and findings from MacLellan et al. (2015) follow those of Raymond et al. (1992), wherein participants’ recollection of T1 and T2 is significantly better when the two targets are separated by a long SOA compared to a shorter SOA. That is, in the MacLellan et al. methodology, the longer time interval between targets minimizes the amount of interference across targets, leading to increased recall performance. The findings from both MacLellan et al. and Raymond et al. suggest the
attentional blink effect is at least partially caused by interference across items.

**Attentional Gating Theory**

There are yet other explanations of the attentional blink effect that have gained prominence in the literature. Raymond, Shapiro, and Arnell (1992) have speculated that there is an attentional gate that opens when an item is detected, but quickly closes so that attention can focus on that item. In the attentional blink procedure, when T1 is detected, the gate opens to allow further processing of that item. The attentional gate quickly closes to avoid interference from other items. However, if an item quickly follows T1, it will be processed as well, leading to processing confusion (Raymond et al., 1992). Once the gate is closed, other items are processed only at an early perceptual level. Proponents of this theory argue that when T2 quickly follows T1, it is not processed beyond the perceptual level because the attentional gate is still closed, with attention focused on the first target (Raymond et al., 1992).

Similarly, Chartier, Cousineau, and Charbonneau (2004) have suggested an attentional gating to account for the attentional blink effect. The authors argue that before entering working memory, stimulus information passes through feature networks. For example, when processing a green “2”, the stimulus information would pass through one network that codes the digit information and another network that codes the colour information. When a stimulus feature matches a mental template for a target item, the attentional gate opens. When a stimulus is identified while the gate is open, it will receive a higher weight than a stimulus will receive if it is identified while the gate is closed (Chartier et al., 2004). The attentional gate becomes less efficient when another stimulus is in the gate attempting to be encoded into working memory at the same time. The
attentional blink effect occurs because T2 is given less weight because it is unable to enter the gate due to T1 being there and the gate’s slow recovery time (Chartier et al., 2004).

**Theoretical Conclusions**

The attentional blink effect is a well-studied phenomenon, that has been used as a gauge of the capacity limitations of attention and its effect on short-term memory. From the many studies that have investigated the attentional blink effect, Raymond et al. (1992) determined three conclusions: 1) the effect is not caused by low-level sensory factors; 2) the effect is not due to memory span deficits; and 3) processing of the first target has to be interrupted by another visual stimulus to produce the effect.

According to Dux and Marois (2009), the attentional blink effect is partially the result of devoting too many capacity-limited attentional resources to T1, meaning T2 does not receive enough attentional resources for adequate processing and subsequent recollection. The attentional blink effect reflects a competition for attentional resources related to memory encoding, episodic registration, response selection, target representations, and distractor inhibition (Dux & Marois, 2009). As a result of T1 processing, attentional resources are unavailable to adequately process T2. With many different theories to explain the attentional blink effect, it is difficult to decide which best fits the diversity of results. Dux and Marois (2009) propose a multifactorial approach to the attentional blink effect because numerous processes have been linked to this attention and memory deficit. They also theorize that capacity-limited attentional resources are the underlying process that causes the attentional blink effect.

However, Olivers and Van de Burg (2008), conclude that the attentional blink
effect could not be the result of limited-capacity attentional resources because they found that improved performance for one target did not affect performance for the second target. Thus, the attentional blink cannot be caused by competition between T1 and T2. Olivers and Nieuwenhuis (2006) come to a similar conclusion. While most theoretical accounts of the attentional blink effect point to unavoidable processing deficits, these authors found that the attentional blink effect can also be modulated by manipulating participants’ mental state. Olivers and Nieuwenhuis (2006) suggest that limited-capacity processing stages could be overwhelmed by items that follow each other in close succession if too much attention is being used for the RSVP stream as a whole.

**Modulation of the Attentional Blink Effect**

Studies have begun to accumulate demonstrating that the robust memory deficit seen in the attentional blink effect can be modulated, with some manipulations producing larger deficits and others producing smaller deficits. For example, Olivers and Van der Burg (2008) added an auditory cue to the traditional RSVP task. They predicted that the attentional blink effect would be reduced when an auditory cue was presented alongside the targets because the targets would have stronger multimodal perceptual representations. In one experiment, Olivers and Van der Burg paired the presentation of T2 with an auditory cue to examine whether the pairing would strengthen T2 processing and thus result in accurate recollection of that item. When T2 was accompanied by an auditory cue, T2 performance improved to such a level that it was no worse than T1 performance (Olivers & Van der Burg, 2008). In other words, hearing an auditory cue simultaneously with the presentation of T2 helped reduce the attentional blink deficit. These results suggest that sound can automatically improve visual processing because
target performance improves when a sound is presented simultaneously with the target. Reducing the attentional blink effect with sound demonstrates that the modulation is perceptual and partially automatic (Olivers & Van der Burg, 2008). Olivers and Van der Burg (2008) conclude that auditory cues can increase the saliency of simultaneously presented visual stimuli, causing a cross-modal effect.

Vroomen and de Gelder (2000) report evidence that the timing of the auditory cue is crucial. The authors presented participants with a RSVP task in which they had to detect a target pattern among distractor patterns. When a target pattern was presented simultaneously with an irrelevant auditory cue, target detection accuracy improved. Vroomen and de Gelder argued that the auditory cue was not acting as a warning signal or alert. When the auditory cue was presented 250 ms before the target—a time when an alerting signal should be functioning at its highest—there was no facilitatory effect for target detection. That is, the auditory signal had to be presented simultaneously with the target. Vroomen and de Gelder argued that the improved accuracy was due to a stronger perceptual signal for the visual target because the auditory cue caused the target to separate from the RSVP stream. This signal, they argued, causes the target to be available to consciousness for longer, improving recall.

Olivers and Nieuwenhuis (2006) found that over-concentrating on the RSVP stream increases the magnitude of the attentional blink effect. When participants had to remember a random line pattern while detecting targets in the RSVP stream, the attentional blink effect was significantly smaller than if they only had the primary task of concentrating on the RSVP stream. Since participants had to divide attentional resources between the RSVP task and remembering the line patterns, fewer distractors were
admitted into the processing stage, therefore there was less interference with targets (Olivers & Nieuwenhuis, 2006). The authors concluded that trying too hard to encode targets leads to the encoding of some distractors as well, causing interference. By using a more diffuse state of processing, fewer distractors will be encoding, causing less interference with targets.

Olivers and Nieuwenhuis (2006) further made this point by presenting participants with images that corresponded with either positive affect, neutral affect, or negative affect. When participants were presented with positive-affect images, their T2 performance improved relative to participants presented with neutral-affect images or negative-affected images. Olivers and Nieuwenhuis (2006) concluded that these results were not due to positive-affect images being more arousing because negative-affect images were similarly arousing according to ratings. Rather, they argued that the positive affective images lead to a more diffuse state of processing, leading to a decrease in the magnitude of the attentional blink effect.

**The Attentional Blink Effect in Summary**

The attentional blink effect is a clear demonstration of the capacity limitations of attention and its impact on short-term memory. The attention system is selective by nature and requires time to engage, process, and disengage from a stimulus. While processing one stimulus, if another stimulus is presented shortly afterwards, the second stimulus will not be adequately attended and, therefore, will not be adequately encoded into memory. Although the attentional blink effect can be modulated to a degree, most studies show the effect is robust, leading to the conclusion that adequately encoded information requires dedicated attention and dedicated attention requires time.
The Attentional Boost Effect

While the attentional blink effect is an excellent demonstration of how inadequately attended information leads to poor memory, others have used the RSVP task to demonstrate that engaging attention leads to strong memory. Rather than have participants selectively attend to targets in an RSVP task, Swallow and Jiang (2010) had their participants attend and memorize all the items in the stream. In one experiment, participants were presented with a stream of pictures and asked to memorize each image for a later long-term memory test. In addition to memorizing the pictures, participants also had to attend to a small coloured square that appeared in the centre of each picture. On most trials, the square was white, and participants simply had to memorize the picture. However, on a rare number of trials the square was black, in which case participants were required to press a button in addition to memorizing the picture. Pictures presented simultaneously with the black squares and responded to with a button press (i.e., target trials) were remembered significantly better than pictures presented with white squares, with no button press (i.e., distractor trials). Swallow and Jiang named this finding the attentional boost effect, as if attention was boosted by detecting an irrelevant target square. This boost in attention, argued the authors, was caused by detecting and responding to the irrelevant stimulus. The boost in attention extended beyond the coloured square to other items in spatiotemporal proximity (i.e., the picture), leading to enhanced memory for those items. The attentional boost effect is a surprising finding given the capacity limitations of attention, as demonstrated by the attentional blink effect. The attentional boost effect is also surprising given the large number of studies that show engaging in multiple tasks simultaneously usually leads to poor performance as attention
is spread across the tasks.

**Context of the Attentional Boost Effect**

Similar to the conclusions of Olivers and Van der Burg (2008) that alerting does not reduce the attentional blink effect, the attentional boost effect does not seem to be caused by alerting. Makovski, Swallow, and Jiang (2011) examined whether increased attention to a target letter would increase visual short-term memory (VSTM) for a colour array. They used this approach as a way to determine the timing parameters of the attentional boost effect and whether the effect is due to motivation, task engagement, or arousal. Participants were presented with a colour array that consisted of three different colours circled around a fixation letter. Participants had to detect whether a “T” was presented at fixation, at which pointed they pressed the space bar. Shortly after the first colour array was presented, a second colour array was presented, which also consisted of three colours but had no fixation letter. Participants had to determine whether the second colour array was the same or different from the first colour array; that is, whether all the colours were the same and in the same spatial location (Makovski et al., 2011). Results indicated that VSTM improved when target letters were presented alongside colours, demonstrating an attentional boost effect due to perceptual processing of all information (Makovski et al., 2011).

To more directly assess whether arousal, engagement, or motivation could contribute to the attentional boost effect, in a second set of experiments, Makovski et al. (2011) presented the target and distractor signals either just before or just after the to-be-remembered colour array. In both of these cases, there was no difference in memory performance between target trials and distractor trials. These findings lead the authors to
conclude that the targets do not act to increase arousal, motivation, or task engagement. If that were the case, then memory performance should improve when the target signals appear just before the to-be-remembered items. Instead, the target signals must appear simultaneously with the to-be-remembered items in order to measure an attentional boost effect (Makovski et al., 2011).

It is also important to note that it is not the mere presence of the target signals that leads to a boost in attention. Rather, participants must monitor the boost signals and actively detect the target signals. Most experiments will include both a divided attention condition and a full attention condition (e.g., Swallow & Jiang, 2010; Mulligan, Spataro, & Picklesimer, 2014). In the divided attention condition, participants are required to memorize the stream of stimuli, as well as monitor and detect target boost signals. In the full attention condition, the target and distractor signals still appear simultaneously with the to-be-remembered items, but participants are told only to memorize the primary stimuli. That is, they are told nothing about the target and distractor signals. It is only in the divided attention condition, in which participants are actively monitoring and detecting target signals, that improved memory is seen for target trials.

**Modality of the Attentional Boost Effect**

The modality of the to-be-remembered items and the boost signals does not affect the likelihood of measuring the attentional boost effect. Swallow and Jiang (2010) replicated their attentional boost effect method, but instead of visual targets being presented simultaneously with images, participants detected auditory tones while memorizing the images. Images presented with the auditory target were better recognized than images presented with distractors. Lin, Pype, Murray, and Boynton (2010) used a
similar procedure whereby participants viewed a RSVP stream of scenes while detecting an auditory tone. Lin et al. (2010) found that memory was better for scenes presented simultaneously with the auditory targets than the auditory distractors, replicating the previous finding (Swallow & Jiang, 2010). These results suggest that the attentional boost effect is not due to the spread of modality-specific perceptual processing, but rather the spread of modality-independent attention.

Further, Mulligan et al. (2014) studied the opposite cross-modality by presenting to-be-remembered stimuli aurally and presenting boost signals visually. They found an attentional boost effect, with words heard with a concurrent visually presented target better remembered than words heard with a concurrent visually presented distractor. This is the first evidence that the attentional boost memory benefit is not limited to visual stimuli (Mulligan et al., 2014). Overall, Mulligan et al. concluded that the attentional boost effect is not modality-specific because the size of the effect is similar in magnitude across modalities.

**Theoretical Accounts of the Attentional Boost Effect**

Swallow and Jiang (2010) concluded that the attentional boost effect is the result of a boost in attention, rather than perceptual saliency. The attentional boost effect is not observed when participants are not required to detect and respond to the target signals, demonstrating that the boost in attention is not simply a matter of perceptual saliency. Furthermore, Swallow and Jiang observed an attentional boost effect when the target and distractor signals contained colour-shape feature conjunctions. In this case, participants were asked to memorize a stream of images and to monitor for a red ‘X’ target among distractors made up of other red letters and ‘X’s in other colours. If the attentional boost
effect is based on perceptual saliency, there ought to be a boost effect for both targets and distractors that resemble the target on some perceptual feature. However, this was not the case. Rather, the boost effect occurred only for target items. Thus, something other than perceptual saliency must be driving the effect. The attentional boost task requires attention to bind the features of the targets (e.g., coloured squares) and to-be-remembered items (e.g., pictures) into a single object. This binding causes an increase in attention during target detection that leads to better memory for simultaneously presented scenes (Swallow & Jiang, 2010).

**Secondary Task Facilitation and Secondary Task Interference**

The attentional boost effect is a combination of secondary task facilitation and secondary task interference (Swallow & Jiang, 2010). Secondary task facilitation occurs when target detection increases attention and makes participants more sensitive to the perceptual features of other stimuli in close spatiotemporal proximity (Makovski et al., 2011). On the other hand, secondary task interference occurs when target detection increases processing demands, leading to the attention system becoming overwhelmed (Swallow & Jiang, 2010). In the case of the attentional boost procedure, the simple detection task adds few additional attentional demands. Thus, secondary task facilitation and secondary task interference add to a net facilitation, causing an increase in attention rather than a decrease (Swallow & Jiang, 2010). This net facilitation decreases interference between target detection and stimuli encoding (Makovski et al., 2011). However, the more demanding target detection becomes, the more interference and less facilitation occurs, overwhelming the attention system. The transient attention hypothesis states that target detection facilitates attention to concurrently presented information
(Makovski et al., 2011). This can even be observed in limited-capacity short-term memory stores, such as VSTM. When participants attend more to concurrently presented information, they are better able to recall it later.

A dual-task interaction model has been proposed to explain the attentional boost effect. According to this model, sensory information from the primary task stimulus (e.g., pictures) and the secondary task stimulus (e.g., coloured squares) is selected by the central executive to go through the early stages of perceptual processing (Swallow & Jiang, 2013). The two stimuli compete for processing at this stage, leading to dual-task interference. Dual-task interference is also caused by the need to maintain multiple goals simultaneously (e.g., detect and remember). After the participant has categorized the secondary stimulus as a target or distractor, they must make a response, which triggers temporal selective attention (Swallow and Jiang, 2013). In most dual-task procedures, temporal selective attention inhibits performance, but in the case of the attentional boost procedure, it enhances processing of all perceptual information that was simultaneously presented with the target, thus improving memory performance for the primary stimulus.

Swallow and Jiang (2014) argue that there are several potential sources of interference when processing stimuli in the attentional boost procedure. Interference could occur when participants are correctly detecting a target or correctly rejecting a distractor, in which case the processes specific to these items could later interfere with memory performance (Swallow & Jiang, 2014). This, they argue, is item-specific interference. Another source of interference could be because of the multiple rules and goals of the concurrent tasks that need to be maintained in memory while the tasks are being performed. This, they argue, is task-specific interference. Task-specific
interference is what is generally seen in dual-task procedures, where participants have to maintain and respond to two separate tasks at once, causing a deficit in performance.

**Attentional Gating Theory**

Active memory is controlled by a mechanism similar to the gating mechanism associated with goal-maintenance and cognitive control (Swallow & Jiang, 2010). When an event changes, such as the presentation of a target, the gating mechanism activates and the internal representations of that event are updated. The attentional boost effect occurs because the presentation of a target cues the opening of the attentional gate, which improves perceptual processing of the item presented in spatiotemporal proximity to the target (Swallow & Jiang, 2010). Attentional gating theories presume that target detection improves attention to perceptual representations. Thus, the attentional boost effect could occur because targets cause an up-regulation of attention to the images when presented simultaneously with the target (Swallow & Jiang, 2010). When a target is presented, it causes an attentional orienting response that opens an attentional gate. The locus coeruleus is one structure that has been implicated in this type of alerting, orienting, and updating, by causing an up-regulation of attention. According to Swallow and Jiang (2010), when the attentional gate is open, processing and encoding of task-relevant information is facilitated.

**The Present Study**

Memory requires attention. The attentional blink effect demonstrates that when attention is impoverished, memory suffers. The attentional boost effect, on the other hand, demonstrates that when attention is enhanced, memory benefits. Previous research has shown that the attentional blink effect deficit can be overcome to some degree. For
example, Olivers and Van der Burg (2008) demonstrated the attentional blink effect can be reduced with the mere presence of an auditory signal during the presentation of T2. There were two goals of the present study: 1) to replicate Olivers and Van der Burg’s (2008) modulation of the attentional blink effect using auditory tones, but using MacLellan et al.’s (2015) two-target attentional blink method, and 2) to uncover whether the addition of an attentional boost manipulation to the attentional blink procedure could further reduce or even eliminate the attentional blink deficit.

**Experiment 1**

To investigate these issues, in Experiment 1, participants completed a two-target attentional blink task (MacLellan et al., 2015) combined with an attentional boost procedure (Swallow & Jiang, 2010). In addition to the typical T1 and T2 words presented during the attentional blink task, tones appeared during the presentation of the second target. However, rather than using only one tone (Olivers & Van der Burg, 2008), participants heard two tones; one tone occurred on the majority of trials and served as the distractor tone, the other occurred on a rare number of trials and served as the target tone. Participants in the divided attention condition were required to perform the attentional blink task, while also monitoring and responding to the tones. When a target tone was detected, they were expected to press a button. In the full attention condition, participants heard the tones but were not told about them. Their goal was only to perform the attentional blink task.

There were several hypotheses for Experiment 1. First, it was hypothesized that participants would show an attentional blink effect. That is, that recall of the T1 and T2 words would be better on trials with no distractor word at T1 (i.e., no selection trials)
than on trials with a distractor word at T1 (i.e., selection trials), but that this effect would be contingent on the SOA between T1 and T2, with the larger difference at the shortest SOA and the smaller difference at the longest SOA. Second, it was hypothesized that overall recall performance would be better in the divided attention condition than the full attention condition. Third, and most importantly, it was hypothesized that participants would show an attentional boost effect. That is, recall of the T1 and T2 words would be better on target trials than on distractor trials, but that this difference would only be apparent in the divided attention condition, not the full attention condition.

Methods

Participants

Thirty-two undergraduate students enrolled in an introductory psychology course volunteered to participate in this experiment, all of whom were given partial course credit in exchange for their participation. All participants reported having normal or corrected-to-normal vision and hearing, as well as the ability to read and speak English fluently.

Apparatus and Stimuli

Stimuli were presented on a MacBook Pro laptop with a screen size of 13.3 inches and display resolution of 1280 x 800 pixels. The experiment was run using PsychoPy programming software (Peirce, 2007; 2009). Manual responses were recorded using a standard computer keyboard. Participants were seated approximately 60 cm from the computer screen.

On each trial, words were randomly drawn from a list of eight five-letter words (MacLellan et al., 2015): BREAD, PLACE, CHIEF, RIGHT, STICK, DREAM, FLUTE, and GRAIN. On each trial, one word was randomly selected to serve as target 1 (T1) and
another was randomly selected to serve as target 2 (T2). On half the trials, an additional word was randomly selected to serve as a distractor and appeared interleaved with T1. The T1 word was presented in red font, the T2 word was presented in white font, and the distractor word was presented in green font. A pattern mask was presented following T2, consisting of the symbols “X” and “&” superimposed at each of the five locations where the five letters in the T2 word had appeared, as seen in Figure 1.

On each trial, an auditory tone was presented simultaneously with the presentation of T2. The auditory signal could be either a low or high tone, separated by two octaves. For half of the participants, the low tone was presented on 80% of trials and the high tone was presented on 20% of the trials. For the other half of participants, the high tone was presented on 80% of trials and the low tone was presented on 20% of trials. The presentation of the low and high tones was randomly selected on each trial for all participants.

**Procedure**

After reading and signing an experimental consent form, participants were given the task instructions both verbally by the experimenter and visually on the computer screen.

As seen in Figure 1, each trial began with the presentation of a fixation cross, centred on the computer screen for 1000 ms. The presentation of the T1 word immediately followed the fixation cross and remained on the screen for 100 ms. On half the trials, the T1 word was presented alone in red. On the other half of trials, the T1 word was presented in red, but interleaved with a green distractor word. Following T1 presentation, there was a variable stimulus onset asynchrony (SOA) of either 233, 467, or
700 ms. The SOA was randomly selected on each trial. The T2 word was then presented in white for 100 ms.

An auditory tone was presented for 100 ms simultaneously with the presentation of T2. On 80% (i.e. distractor tone) of the trials, the tones were of one frequency (high or low) and on 20% (i.e. target tone or boost signal) of the trials the tones were of the other frequency. This was counter-balanced across participants. Participants in the full attention condition heard the tones but were told nothing about them. Rather, they were told only to attend and remember the T1 and T2 words. Participants in the divided attention condition pressed a key whenever they heard a target tone in addition to attending and remembering the T1 and T2 words.

The T2 word was followed by a pattern mask for 200 ms. At the end of each trial, participants were required to recall the T1 and T2 words, in the order in which they were presented. The participant’s response was recorded before moving on to the next trial.
Trials that have a distractor presented interleaved with the T1 word (i.e., selection trials) occurred randomly 50% of the time. The three SOAs also occurred randomly. The assignment of the tone frequency (i.e., high or low) to presentation rates (80% or 20%) was counterbalanced across participants. The presentation of the high or low tone on any given trial occurred randomly for all participants. In total, participants completed 390 trials.

At the end of the experiment, participants were fully debriefed. The nature of the experiment, including the hypotheses and expected results, were explained by the experimenter. The participants also received a debriefing form detail the nature of the experiment.

Results

To calculate accuracy in the boost detection task, a hit rate corrected for the false alarm rate (i.e., hits minus false alarms) was computed separately for each condition. As was expected, participants made no button press responses in the full attention condition, therefore the analysis focused on the divided attention condition. These mean corrected hit rates were submitted to a repeated measures analysis of variance (ANOVA) that treated SOA (233/467/700 ms) and selection (selection/no selection) as factors. An alpha level of .05 was used for this test and all those that follow. Overall, the corrected hit rate was high ($M = .97$), with participants correctly responding to the boost signal on the majority of trials. Moreover, there were no differences in the corrected hit rate across the conditions. The analysis failed to uncover an effect of selection, $F (1, 15) = .57, MSE = .004, p = .46$, or SOA, $F (2, 30) = .53, MSE = .002, p = .60$. Furthermore, these factors did not interact, $F (2, 30) = .70, MSE = .004, p = .50$. 
To assess recollection of the T1 and T2 words, mean rate of correct responses to T2, given that T1 was also correctly recalled, were calculated for each condition. These means were then submitted to a mixed factor ANOVA that treated condition (full/divided) as a between-subjects factor and boost signal (target/distractor), SOA (233/467/700 ms), and selection (selection/no selection) as within-subjects factors.

![Figure 2](image.png)

Figure 2. Percent correct T2 identification given a correct response to T1 as a function of trial type (boost/distractor), selection (selection/no selection), and SOA in the divided attention condition.

The analysis failed to reveal an effect of condition, $F(1, 30) = .05$, $MSE = .02$, $p = .82$. Thus, participants who had to divide their attention between target words and target tones performed no better than participants who only had to attend to target words, as seen in Figure 2 and Figure 3. There was also no significant main effect of boost signal, $F(1, 30) = .12$, $MSE = .001$, $p = .74$. Thus, memory performance was not significantly different on target tone trials ($M = .79$) compared to distractor tone trials ($M = .79$). However, there was a significant main effect of selection, $F(1, 30) = 31.61$, $MSE = 3.91$, $p < .001$, such that memory performance was significantly better for no selection
trials ($M = .89$) than selection trials ($M = .69$). A significant main effect for SOA was also revealed, $F (2, 60) = 43.88$, $MSE = .73$, $p < .001$. Memory performance was worse at the shortest SOA ($M = .72$), showed an improvement at the medium SOA ($M = .79$), and the improvement increased at the longest SOA ($M = .87$).

![Figure 3](image-url)

Figure 3. Percent correct T2 identification given a correct response to T1 as a function of trial type (boost/ distractor), selection (selection/ no selection), and SOA in the full attention condition. Note. To remain consistent with Figure 2 “Target Tone” and “Distractor Tone” were used to describe the presentation rates of tones. However, the tones had no meaning in this condition.

The analysis failed to reveal significant interactions between condition and boost signal, $F (1, 30) = 2.64$, $MSE = .02$, $p = .12$, condition and selection, $F (1, 30) = .01$, $MSE = .002$, $p = .91$, or condition and SOA, $F (2,60) = .98$, $MSE = .02$, $p = .38$. Additionally, there was no interaction between boost signal and selection, $F (1, 30) = .05$, $MSE < .001$, $p = .82$, or between boost signal or SOA, $F (2, 60) = .17$, $MSE = .001$, $p = .85$. However, there was a significant interaction between selection and SOA, $F (2, 60) = 13.41$, $MSE = .20$, $p < .001$. Memory performance on selection trials at short ($M = .57$), medium ($M = .70$), and long ($M = .80$) SOAs differed significantly from memory performance on no
selection trials at short ($M = .86$), medium ($M = .88$), and long ($M = .94$) SOAs. As seen in Figure 2, this interaction serves as a successful demonstration of the attention blink effect, wherein memory performance on selection trials improved as the SOA became longer.

None of the three-way interactions or the four-way interaction reached significance.

**Discussion**

An attentional blink effect was discovered wherein T2 accuracy suffered at the shortest SOA in selection trials but improved at the longer SOA. However, participants’ T2 accuracy did not improve when they had to respond to boost signals presented simultaneously with T2, thus an attentional boost effect was not observed and as such no modulation of the attentional blink effect.

These results contribute to the large body of research that has found that memory suffers when targets are presented in close succession of each other. Results also replicated MacLellan et al.’s (2015) findings, demonstrating that the attentional blink effect can be manipulated by temporal and spatial selective attention. This could suggest that the attentional blink effect is caused by insufficient resources, where there are insufficient attentional resources to be shared across T1 and T2 (Raymond et al., 1992). It is possible that too many attentional resources were dedicated to selectively attending to T1 while rejecting the distractor that when it came time to process T2, there were not enough resources to do so, which led to a poorer performance for T2 accuracy.

Even if there were insufficient resources to correctly report T2, evidence has shown that T2 is still processed, but not to a level that is sufficient for a response. For
example, Shapiro et al. (1997) used a three-target RSVP task to demonstrate that T2 is processed even if participants are unable to report it. On trials in which participants were unable to report T2, T2 still acted as a prime for T3. That is, participants performed better when T2 and T3 were related than when they were unrelated (Shapiro et al., 1997). Thus, even when there are limitations reporting T2, it is still processed at a level high enough to influence the processing of T3. This provided evidence that both T1 and T2 were being processed, but T1 was receiving more processing resources.

An attentional blink effect could have been observed because of a delayed re-engagement. This theory was proposed by Nieuwenstein, Chun, Van der Lubbe, and Hooge (2005) and explained that presentation of T1 engages top-down attentional resources to T1. However, these resources are disengaged once target information stops due to a blank interval or a distractor. The attentional blink effect occurs because participants cannot quickly re-engage the top-down processes necessary to encode T2 (Nieuwenstein et al. 2005). Nieuwenstein et al. (2005) presented a distractor before T2 that shared featural characteristics with T2. They found that the attentional blink effect was decreased because attention was re-engaged immediately before T2 was presented. Additionally, when Nieuwenstein and Potter (2006) asked participants to report all stimuli in the RSVP stream the attentional blink effect was almost non-existent under this experimental condition because participants’ attention was constantly engaged.

However, delayed re-engagement theory works best for the traditional RSVP task, whereas in the current study’s procedure, participants must engage, disengage, and then re-engage attention when processing T1 and T2 when there is the additional spatial selection task (MacLellan et al., 2015). In these circumstances the attentional blink effect
is less likely to be reduced. When there are no spatial selection demands, however, the attentional blink effect is reduced.

**Experiment 2**

One limitation of the first experiment is that it cannot be determined whether the effect reported by Olivers and Van der Burg (2008) has been replicated. The Olivers and Van der Burg effect would be found in the full attention condition in Experiment 1, but without a control condition, that effect could not be properly measured. To overcome that limitation, a second experiment was conducted. In Experiment 2, half of the participants completed a task that was the same as the task in the full attention condition in Experiment 1. The other half of participants completed a task that was similar but had no tones. That is, it was important to compare performance in the attentional blink task when there were tones present at T2, but required no response, to performance in the attentional blink task when there were no tones. The main hypothesis for Experiment 2 was that recall of the T1 and T2 words would be better on selection trials in the condition with tones than on selection trials in the condition without tones. This could be considered a successful replication of the Olivers and Van der Burg effect.

It is important to note that due to the university campus closure, the data collection for Experiment 2 was not completed. Nonetheless, the data that was collected was analyzed and reported below.

**Methods**

**Participants**

Five undergraduate students enrolled in an introductory psychology course volunteered to participate in this experiment, all of whom were given partial course credit
in exchange for their participant. All participants reported having normal or corrected-to-normal vision and hearing, as well as the ability to read and speak English fluently. None of these participants had participated in Experiment 1.

**Apparatus and Stimuli**

The apparatus and stimuli used in the current experiment were the same as those used in Experiment 1.

**Procedure**

The procedure used in the current experiment was similar to the procedure used in Experiment 1. Half of the participants in the current experiment completed a task that was identical to the task used in the full attention condition in Experiment 1. That is, auditory tones were presented simultaneously with the presentation of the T2 word, however, the sole task was to attend and memorize the T1 and T2 words; no response was required to the auditory tones. The other half of participants completed a similar task, however, there were no auditory tones presented, also with the sole task of attending and memorizing the T1 and T2 words.

**Results**

To assess recollection of the T1 and T2 words, mean rate of correct responses to T2, given T1 was also correctly recalled, were calculated for each condition. The means were then submitted to a mixed factor ANOVA that treated condition (tones/no tones) as a between-subjects factor, and SOA (233/467/700 ms) and selection (selection/no selection) as within-subjects factors.

As seen in Figure 4 and Figure 5, the analysis failed to reveal an effect of condition, $F (1, 3) = .002, MSE = .00, p = .97$, indicating memory performance was
statistically the same across the auditory condition and the no auditory condition. There was also no effect of selection, $F(1, 3) = 2.15, MSE = .24, p = .24$, with no difference in memory performance on selection trials ($M = .67$) and no selection trials ($M = .88$). There was, however, a significant effect of SOA, $F(2, 6) = 13.70, MSE = .07, p = .006$, with memory performance worse at the shortest SOA ($M = .69$), better at the medium SOA ($M = .78$), and best at the longest SOA ($M = .86$).

The analysis failed to reveal an interaction between condition and selection, $F(1, 3) = 1.04, MSE = .12, p = .38$, or between condition and SOA, $F(2, 6) = .28, MSE = .001, p = .77$. However, there was a significant interaction between selection and SOA, $F(2, 6) = 7.37, MSE = .03, p = .02$. Memory performance on selection trials at short ($M = .53$), medium ($M = .67$), and long ($M = .82$) SOAs differed significantly from memory performance on no selection trials at short ($M = .85$), medium ($M = .89$), and long ($M = .90$) SOAs. Despite the small number of participants, this interaction is an encouraging
sign that an attentional blink effect can be observed. The three-way interaction between condition, selection, and SOA was not significant, $F (2, 6) = .93, MSE = .004, p = .45$.

**Discussion**

With very few participants, it is difficult to draw strong conclusions from Experiment 2. Even with limited data, however, Experiment 2 did produce an attentional blink effect. The accuracy of recalling T2 was worse on selection trials at the shortest SOA but got progressively better at the medium and longest SOA. Again, this is a demonstration of the attentional blink task using the two-target method (MacLellan et al., 2015). No Olivers and Van der Burg (2008) was found, wherein T2 accuracy improved in the auditory condition compared to the no auditory condition. However, due to the limited data these results are not indicative that the Olivers and Van der Burg (2008) effect cannot be replicated. These results may indicate that the lack of attentional boost
effect found in Experiment 1 was not because performance was already being improved with the tones alone.

**General Discussion**

The current study examined whether the attentional blink effect could be reduced with sound and whether it could be further reduced by responding to the sound, thus combining an attentional boost methodology to an attentional blink methodology. The results from Experiment 1 showed that an attentional blink effect was obtained when participants had to spatially and temporally select target words from a distractor word. However, responding to target auditory tones did not modulate the attentional blink deficit. In a second experiment, the influence of tones without a detection or response requirement was assessed (Olivers & Van der Burg, 2008). Although an attentional blink effect was found, the size of the effect was not contingent on the presence of auditory tones. Given the small sample size used in Experiment 2, what follows focuses largely on Experiment 1, which used a larger, more representative sample.

In Experiment 1, when participants had to selectively attend to target words amid a distractor words, their T2 accuracy suffered, especially at the shortest SOA, which replicates MacLellan et al.’s (2015) results. However, no attentional boost effect was observed in the divided attention condition, wherein memory did not improve when participants responded to a boost signal presented simultaneously with T2. This result is contradictory to one of Swallow and Jiang’s (2010) experiments, where they found an attentional boost effect for memory of visually presented images when participants had to respond to an auditory target. It is important to note, however, that the attentional boost described by Swallow and Jiang was in long-term memory. In the present set of
experiments, short-term memory was probed, as is typical of attentional blink tasks.

In both experiments, the attentional blink effect was most pronounced in the selective attention trials, where participants had to select T1 from the distractor word, at the shortest SOA, as found by MacLellan et al. (2015). These results could be explained through the lens of numerous theories, such as interference theory and attentional gating theory. Interference theory suggests that T1 and T2 compete with each other in a short-term storage buffer, but T1 usually wins and thus T2 accuracy suffers. When T1 was presented, there was time to create a perceptual representation of it and give it a high weighing because there was ample space in the short-term storage buffer (Shapiro et al., 1994). However, since T2 followed so quickly after the demanding task of identifying T1, it was able to have a perceptual representation created, but it was given less weight than T1 because there was less space in the short-term storage buffer. Since T1 had more weight than T2, it interfered with T2 recall and as such resulted in the performance deficit. At the longer SOA, T2 accuracy was significantly higher and almost at the accuracy for no selection trials. This provided strong evidence for an interference theory to explain the attentional blink effect because the effect is most pronounced when there is less time between targets compared to when there is more time between targets, which suggests that T1 interfered with T2 when there was less time to “recover” from selectively attending to T1.

Another possible explanation for the attention blink effect that was found is the attentional gating theory. The attentional gating theory proposes that an attentional gate opens when an item is detected, but quickly closes so that attention can focus on that one item (Raymond, Shapiro, & Arnell, 1992). In this case, the attentional gate would have
opened, allowing T1 and the distractor to enter the storage buffer, but immediately afterwards would have closed. T1 would be processed to a sufficient level so as to allow it to be processed instead of the distractor. Because the attentional gate was closed when T2 was presented, T2 was not able to enter the attentional gate and as such was not able to be processed to a level to aid recall. However, at the longer SOA, there was more time for the attentional gate to open, close, and then open once again.

The attentional gating theory does not seem to account for the pattern of results shown in the current study and MacLellan et al.’s (2015) study. The attentional gating theory explains the attentional blink effect seen in selection trials but does not seem to account for the results found in the no selection trials. If an attentional gate opened for T1 and closed before T2 entered, then an attentional blink effect would be expected to have been seen in the no selection trials, which was not the case. Because performance in no selection trials was significantly better at all SOAs, it cannot be the case that an attentional gate was opening for T1, leaving T2 outside the gate and thus resulting in worse performance. Thus, an attentional gating theory cannot account for the attentional blink effect found in this methodology because it cannot fully explain all the results.

In Experiment 1, the attentional blink effect was not modulated by the attentional boost manipulation, meaning that participants in the divided attention condition did not have better T2 accuracy when they responded to boost signals compared to participants in the full attention condition. These results could be explained in several different ways, namely the overinvestment hypothesis, secondary task interference, and a target-distractor trade-off account.

The overinvestment hypothesis was proposed by Olivers and Nieuwenhuis (2006)
to explain the attentional blink effect, but it could also explain why the attentional boost effect did not modulate the deficit. The hypothesis proposed that when participants use too many attentional resources (e.g., they try too hard), it causes interference which impacts recollection of T2. According to this theory, all items in the RSVP stream are processed perceptually. But, additional attentional resources are required in order to process and represent the items conceptually. This second processing stage has a limited capacity, but once items are processed at this stage they are prepared for recollection and report (Olivers & Nieuwenhuis, 2006). When participants use too many attentional resources (e.g., they try too hard), targets, as well as distractor items enter the second stage of processing—leading to interference and thus the attentional blink effect. It is possible that participants in the first experiment were using too many attentional resources attending to T1 and T2, selecting T1 from the distractor, and monitoring for and responding to boost signals that their performance suffered because too many attentional resources were being used, causing interference between T1 and T2. However, if this were the case it would be expected that performance between divided and full attention would have been significantly different, where full attention would have been significantly better because participants did not have to use as many attentional resources to complete the task. Since this is not the case, the overinvestment hypothesis may not be able to explain the current results because it does not seem as though participants were overwhelmed by the attentional tasks that needed to be performed.

Proposed by Swallow and Jiang (2010), secondary task interference could also explain why the attentional boost effect did not modulate the attentional blink effect. Secondary task interference occurs when target detection increases processing demands.
In Swallow and Jiang’s attentional boost task, secondary task interference is added to secondary task facilitation—target detection increases attention, thus creating a net facilitation and the attentional boost effect (Swallow & Jiang, 2010). Makovski et al. (2011) observed that the more demanding target detection becomes, the more interference and less facilitation occurs, which eliminated the attentional boost effect. It is possible that target detection in the current study was too demanding and as such performance on the secondary task interfered with performance on the primary task, causing no modulation to the attentional blink effect.

A target-distractor trade-off could also explain why the current study found no attentional boost modulation of the attentional blink effect. A target-distractor trade-off could cause interference when it comes time to reporting T1 and T2 (Duncan, 1980). During each trial, participants had to decide whether an auditory tone was a distractor or a target while selectively attending to T1 and attending to T2. These tasks may require the same amount of processing and therefore there was no trade-off between them at encoding. However, Duncan (1980) argued that a trade-off could occur at the response selection stage of processing, where the boost target causes interference. Thus, the act of responding to a boost signal in the divided attention condition caused T2 to be interfered with and led to no accuracy improvements when compared to the full attention condition. Duncan’s (1980) account has been disputed by other researchers, but it could be applicable in the situation of the current study, where attentional blink effect and attentional boost effect methodologies were combined.

What is interesting about the current study is that it contradicts the findings of a companion study done by other researchers. They also examined whether the attentional
boost effect could modulate the attentional blink effect but used a visual boost task.
Rather than tones, coloured boxes appeared around the T2 words and participants in the
divided attention condition had to press a key when a target coloured box appeared. They
found an attentional blink effect in the full attention condition and a significant
modulation of that effect in the divided attention condition for boost signal trials (E.
MacLellan, personal communication, March 2020). This may suggest that using the
attentional boost effect to modulate the attentional blink effect can only be done in one
modality. However, previous research into the attentional boost effect has demonstrated
that it is a cross-modal phenomenon (Swallow & Jiang, 2010; Mulligan et al., 2014).
Furthermore, Olivers and Van der Burg (2008) found a modulation for a visual
attentional blink using auditory tones, which suggests that modulation can be cross-
modal. Future research should examine whether a cross-modal attentional blink and
attentional boost methodology could create a modulation to the attentional blink and
should also attempt to replicate E. MacLellan’s results (personal communication, March
2020).

There are some limitations of the current study. Experiment 1 contained no
control condition, which would have allowed a comparison of the full attention condition
to a condition with no auditory tones. This comparison would have allowed the
assessment of the Olivers and Van der Burg (2008) result, wherein auditory tones alone
reduced the size of the attentional blink effect. In Olivers and Van der Burg’s (2008)
study, a modulation of the attentional blink effect was found when sound was presented
simultaneously with T2. Thus, it is possible that a modulation occurred due to tones alone
in Experiment 1, but it could not be observed because there was no control condition to
compare the full attention condition performance to. Having a control condition could
explain why no attentional boost effect was found in the current study. An attempt was
made to overcome this limitation with Experiment 2. However, due to unforeseen
circumstances this experiment could not be completed.

Another potential limitation are the limited observations used in the divided
attention condition. Observations were only used for analysis if participants correctly
identified T1 and T2 and also correctly detected and responded to a target signal, as well
as correctly not responding to a distractor signal. This may have caused a limited number
of observations to be recorded in some conditions, which could have limited the effect of
the boost manipulation. This may have been further exasperated by the limited time
participants had to respond to boost or distractor signals. If participants correctly
identified a target or distractor signal, but did not respond in the appropriate timeframe,
their data was not used in analyses, which may have reduced the potential effect of the
boost manipulation. It could be beneficial for future studies to increase the time
participants have to respond in order to increase the number of observations used in
analyses and have a greater possibility of finding an effect.

It would also be interesting if in future there was an attempt to combine the
attentional boost and attentional blink tasks, but using the traditional RSVP task. If an
attentional boost manipulation similar to the one used in the current study was added to
the RSVP task, it is possible that a reduction of the attentional blink effect would occur.
Alternatively, this method may produce results similar to those reported in Experiment 1.
Either way, it would be an interesting avenue for future research.

The current study added to the large body of research that has found a robust
attentional blink effect when T2 is presented within a short timeframe after T1, leading to a deficit in memory for T2. The current study also replicated Maclellan et al.’s (2015) study, thus demonstrating that a two-target method can be used to manipulate the attentional blink effect. However, the current study contradicts the body of research that has found an attentional boost effect, where participants have a better memory for stimuli to which they responded to in a secondary task. Further research will have to determine why no attentional boost effect was observed in the current study. It may be the case the dual-task procedures or multi-tasking do not improve memory in some situations but improves it in others.

Overall, the current study demonstrated the strong relationship between attention and memory. When there were insufficient attentional resources, performance on a memory task suffered and when attention was overwhelmed, performance on memory task also suffered. Thus, in order to improve memory, one must first work on improving attention.
References


